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PRODUCTION OF CERTAIN IRIS BULBS

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THE GROUPS TREATED

The genus Iris is very conveniently divided into large groups by the character of the underground parts. The group which includes the common flag iris has a short, thick rootstock; a second group has true bulbs; another group, usually referred to as fibrous rooted, has rootstocks less distinct; and a fourth group has a root structure approaching that of a corm. This circular deals with a part of the second group, that very heterogeneous assemblage having true bulbs, comparable in structure with the onion, the daffodil, and the tulip.

The bulbous group of the genus is itself large, very variable, and made up of many diverse sections, not all of which are of equal importance. The subject to be considered here is therefore limited to include only four natural species of the bulbous section, divided commercially into five more or less distinct categories, as follows:

(1) *Spanish iris.*—The Spanish irises constitute an old group derived mainly, it is said, by seedling selection from *Iris xiphium*, a native of southern Europe, extending from the Spanish peninsula to Italy.

(2) *Dutch iris.*—The Dutch group (pl. 2, A) is similar to the Spanish, but of recent origin and derived mainly through hybridization of the Spanish varieties with *Iris tingitana* and *I. filifolia.*

(3) *Iris filifolia.*—In some of its various forms the filifolia group is native to Morocco and extreme southern Spain. Several varieties are recognized, but the robust Imperator is the most popular.

(4) *Iris tingitana.*—The tingitana iris (pl. 1, A) is a native of Tangier and neighboring regions and has a few varieties listed. It is the native species that is used in commerce, but horticultural varieties are appearing.

(5) *English iris.*—The irises of the English group (pl. 2, B) are said to be derived, like those of the Spanish group, by selection of seedlings of *Iris xiphioides*, native to the Pyrenees Mountains. This species reached Netherlands growers through England, which accounts for the name.

The first four of these groups are closely related and have more in common with one another than with the last one. Indeed, in commercial lists it is not unusual to find *Iris filifolia* and *I. tingitana* listed in either Spanish or Dutch sections. The Spanish and Dutch varieties are very similar in their botanical characteristics, but they differ more in their commercial aspect. It is not uncommon to refer to the first four groups (Spanish, Dutch, *Iris filifolia*, and *I. tingitana*) as xiphiums, in contradistinction to the xiphioides or English group.

LOCATION OF THE INVESTIGATIONS

Investigations of bulbous irises were begun by the Bureau of Plant Industry in 1916 with an importation of 6 varieties of the Spanish and 4 of the Dutch groups. The following year 17 varieties, considered the best of the English, were brought in, and 15 of them were saved. *Iris tingitana* and *I. filifolia* were imported shortly afterwards.

The Dutch, Spanish, and filifolia groups have been handled at Bellingham, Wash.; at the Arlington Experiment Farm, Rosslyn, Va.; and at the Coastal Plain Branch Station of the North Carolina Agricultural Experiment Station, at Willard, N. C. The English iris has been grown mainly at Bellingham and *Iris tingitana* at the United States Plant Introduction Garden at Chico, Calif.

COMPARATIVE IMPORTANCE OF THE GROUPS

Ten years ago the Spanish group included by far the most important of the bulbous varieties, but these are now rapidly giving way to the more robust, larger flowered, and earlier varieties of the rapidly increasing Dutch category. (Pl. 3, A.) Until recently the Dutch group did not contain the range of color that was available in the old Spanish class, but in the last few years these have accumulated remarkably until to-day practically all colors except the bronzes are available in the Dutch section, and even they are beginning to appear. It is true that some of the newer shades are yet rather high in price, but recent reductions in their cost have been most remarkable, showing that they, like the Spanish, are very prolific.

The commercial form Imperator, of *Iris filifolia*, has been prized largely on account of its very robust constitution and great dependability under both field and greenhouse conditions. It makes comparatively large bulbs, is a strong grower, and blossoms about the middle of the season of the Dutch group.

Iris tingitana from its first introduction into the trade, has been of very uncertain quality, the imported no less than the domestic. The complaint of its poor flowering quality is general. The species has an important rôle to fill, however, if dependable flowering quality can be grown into the bulbs. To do this is more difficult than in the xiphiums generally, but there are indications that it may be accomplished through the Wedgewood variety. The early-flowering

quality of this species will then be of great value, and the place which it will occupy may be comparable to that of the Paperwhite in the narcissus.

The English iris has a limited use on account of its lateness of season, its nonforcing qualities, and its adaptability to cool moist climates. These qualities make it useful for garden culture only. But the group is worthy and capable of much more extended use than is now made of it.

AVAILABILITY OF STOCKS

As with so many other bulbous plants, the Netherlands is the great reservoir of supply, although a few come from the British Isles and large quantities from southern France. Until about 10 years ago little attempt was made in this country to produce bulbs of these irises for the market. Since that time very large quantities, about 15,000,000 in the last five years, have been imported for growing on, until now there are considerable domestic supplies with an offering to the market of probably about 25 per cent of the country's consumption in prerestriction days.

Like tulips and daffodils, the forced bulbs of iris are perfectly good for propagation, and a considerable increase of small bulbs will occur in the flats and pots. All of this material is an asset and should be utilized, for the present at least, while planting stock is scarce.

The character and value of the forced bulbs, however, will depend very largely upon the method of handling after the flowers are cut. If the cut is low and the flats are dried off promptly, the bulbs will be much smaller than if the cutting is a little more considerate and the drying takes place a month later. Even when the flats are dried immediately after the flowers have been cut, good planting stocks will result, and there will usually be two or three times as many bulbs as were planted, but of course they will be much smaller.

During the last few years domestic production has been increased sufficiently to warrant the sale of planting stock as well as merchantable sizes, so that it is now possible to obtain some material for growing on from domestic sources.

SOILS FOR BULBOUS IRIS

The soils which are usually recommended for bulbous iris are rich sandy loams. On account of the heavy cropping and the comparatively large amount of hand labor, the soil needs to be abundantly supplied with plant food and should be friable in nature. The English group is better adapted to medium or heavy loams than the others, but light sands and heavy clays should be avoided with all of them.

Satisfactory results have been experienced with all of the groups here considered except *Iris tingitana*, on the more friable of the Whatcom silt soils at Bellingham, Wash., as well as on the sandy loams. At Willard, N. C., the culture has been on a fine sandy loam which packs tightly but does not bake. Results have been much less satisfactory on the coarse, lean sands of an artificial fill on the Arlington Experiment Farm in Virginia.

PLANTING

The writer has no prejudices or preferences as to the plan of a bulbous iris planting. Indeed, at both Bellingham, Wash., and the Arlington farm, Rosslyn, Va., the stocks have been grown in the conventional Dutch bed, but at the Coastal Plain station, Willard, N. C., in 15-inch rows, with nearly equal satisfaction. The one disadvantage in the row method of planting is that the long linear leaves of these plants extend across a 15-inch space and are very likely to be injured or covered by almost any form of cultivation that may be adopted.

The method of planting does not differ from that for bulbs generally. If the Dutch bed method is employed, the beds are opened by excavating to the depth of 4 inches. The bottom of the depression is raked to a level and fined. A marker is then run through the excavation, marking the rows, edges, and center of the planted area; or, the bulbs may be set accurately enough without a marker if the workmen are sufficiently experienced. The bulbs are covered, as usual, with the soil removed in excavating the next bed. This process is continued across the entire plot.

If the row method of planting is followed, there are various ways of preparing the land for setting the bulbs. A method about as effective as any is to arrange a plow for one-horse draft so that the animal can walk on the land, planting being done in each furrow. It may be advisable to run through the furrow with a single-shovel cultivator or with a hand rake to fine the soil better and definitely mark the position of the row. The bulbs are placed by hand and covered by the next furrow.

If planting occurs in wider rows, a trench for setting the bulbs may be made with a single-shovel cultivator of sufficient size to reach the necessary depth. The bulbs when set may be covered by hand, wheel hoe, or harrow.

CULTIVATION

Like most other bulbous stocks adapted to annual digging, a minimum of cultivation is required, and that mainly to destroy weeds. If the soil is suited to the crop and is properly prepared it is doubtful whether stirring it around the plants is of much benefit. More actual cultivation of the soil will always take place in the row than in the bed method of handling.

Iris varieties of the xiphium groups (all considered here except the English) are not so easily handled in the fall as those of the xiphioides and Dutch bulbs generally. The xiphiums and related forms all come up quickly when planted and consequently can not be run over with a wheel hoe in the fall to keep down weeds. More or less handwork is therefore necessary from about a month after planting until winter prevents weed growth. This renders all the more important a thorough preparation of the soil and as much freedom from weed seed as is practicable on land devoted to these crops.

It is imperative that weeds be kept under rigid control because an accumulation of them in a planting of these varieties is about as

discouraging as in a crop of delicate seedlings which are subject to serious injury from either pulling the weeds or letting them alone. Instances have been known within the last few years where commercial growers found it preferable to destroy large areas by plowing the crops under rather than hoe and pull the heavy weed crop that had been allowed to grow. The only practical way to handle this crop is to keep the plantings free from weeds from the start. It is altogether too expensive under present economic conditions to get rid of weeds when once they have become well established.

In these investigations cultivation and weed killing have been accomplished with a wheel hoe accompanied by hand pulling in the beds and rows. When the work is thoroughly done prior to cold weather there is little to be done on the beds in the spring, for, if planted thick, the crop covers the ground fairly well early in the season. The xiphioides or English iris forms, however, are later maturing and consequently come into competition with the late summer weeds as well, but are more easily cared for in the fall.

Much can be done here to economize time and energy by keeping weeds under practical control from blossoming time onward. Absolute freedom from all weeds may not be at all practicable or necessary. Even in these experimental cultures it has often been found advantageous to pull the larger weeds which interfered most with the crop toward the end of the season, without attempting to maintain absolute freedom from small weeds which would not interfere with either the development or the digging of the bulbs thus late in the season. Then, as soon as the crop is out, the land is plowed to prevent the weeds from seeding.

DIGGING

The lifting of the bulbs of bulbous iris takes place as soon as the tops have died in June to early August, depending on the locality. The operation does not differ from the digging of various other bulbous stocks. (Pl. 3, B.) When planted in Dutch beds the bulbs are taken out with a short-handled spade, one row after another across the bed, the workman digging on his knees in the dug-over space. Row plantings are more advantageously dug with a spading fork, one man doing the digging and another the picking up.

Before digging is begun the tops can be gotten rid of by the use of a scythe. The bulbs with the stem and leaf bases attached can then go into the containers, obviating the delay of breaking off the stems while digging, which would be necessary if mowing is not done.

The bulbs of all but the English group are so small and the increase so easily broken off that the crop does not lend itself well to mechanical methods of digging, and the English iris bulbs are so easily bruised that it is questionable whether mechanical methods of digging would prove satisfactory.

For best commercial results the lifting of these varieties should take place annually, but this is less needful with the English group. The bulbs become very crowded and consequently dwindle in size if left two years. (Compare pl. 1, B, and pl. 2, A.)

HANDLING IN STORAGE

All of the groups here considered need to be dried off rather promptly after digging, and in the writer's opinion preferably with moderate air circulation, especially if the storage season is to be a long one, as is likely with southern-grown stocks.

When the digging is done before the tops have disintegrated, as has been the practice in the investigations at Bellingham, Wash., and is likely to be the case in the short seasons in the Northwest, there is little danger from molding if the drying is slow, because when the tops are mowed off the old bases of leaves and stems keep the bulbs from packing closely, thus naturally preventing conditions favorable to the accumulation of moisture and the consequent development of molds.

The bulbs should be quite dry to the touch before cleaning is attempted, and preferably all sap should be out of the old stem and leaf bases. These structures are tough and difficult enough to remove when thoroughly dried, but removal is particularly difficult when they are moist or slightly green.

After the cleaning, opportunity must be given for the healing of the broken surfaces caused by the removal of the offsets. On two occasions at Bellingham the writer experienced serious losses from carelessness in the storage of the stocks, especially of the small sizes, when they were returned from the cleaning benches to the storage trays in layers that were too thick. The moister the atmosphere and the poorer the aeration in the bulb house, of course, the greater the care necessary.

Under the conditions at Bellingham the injury occurred in three days when the bulbs were piled 8 inches high on the 4-foot square trays. The first symptoms were rapid sweating, very slight heating, and subsequent development of blue mold. It is imperative that the broken surfaces be allowed to dry thoroughly before these bulbs are piled on the shelves.

This is only one side, but it is possibly the most important side of the problem of storage of these stocks and is applicable with even greater force to the English group than to the others, because the English varieties are grown in smaller quantities. The other aspect of the situation is the danger of too much drying out of the bulbs caused by excessive aeration or exposure. This fault, while slower in its effect, is just as fatal if continued to the point of desiccation, which is weakening to the stocks. Injury from desiccation occurs to the xiphium group much quicker than to the xiphioides, but the latter deteriorate quicker from other causes.

In the investigations at Bellingham the matter of excessive drying has never been of much concern, because the bulbs are usually dug and reset in August, thus being out of the ground but two or three weeks. In North Carolina, however, where the bulbs are dug the middle of June and held in storage until the middle of October, the danger of drying out too much was considered imminent. On the Arlington farm in Virginia the storage period has been shorter by fully a month, and consequently a lessened storage problem is presented.

In the investigations at Willard, N. C., the danger of excessive drying has been considered so imminent that the bulbs stored on

stacked trays (pl. 4, A) have been draped with burlap curtains during the entire storage period after the surface moisture had been dried off during the first 24 to 48 hours. In one case there was a little loss in the center of the pile due to smothering too quickly after digging. That such protection is advantageous and even necessary is proved by the fact that trays covered with dry sand are the best preserved and by the additional fact that the bulbs, when taken out of such storage, deteriorate by drying out rather rapidly, though rapid deterioration is to be expected after four months of storage in a hot climate. It is interesting and important, however, to note that it has been possible to store these bulbs successfully in a hot climate for four months.

As stated, the storage at Bellingham is on trays 4 feet square in a frame building where about one-third of the wall space is made up of French windows for ventilation. At the Arlington farm the storage space is in a poorly ventilated brick half basement. Here any surface moisture is dried off the bulbs on trays stacked up in shade on the outside before they are put in the racks. If this is not drying enough, an electric fan is used inside to create suitable aeration for a few days until danger is over. At Willard the storage is in a conventional double-walled sweet-potato storage house in which both the bottom and top ventilators have been left open all the time.

It should be said that none of the methods here outlined agrees with some of the commercial practices in the Wilmington, N. C., region, less than 40 miles from the Willard station. Here some of the commercial growers, even after their stocks are cleaned and surface dried, carry them successfully in layers 2 to 4 inches thick on shelves in slatted houses from July to October. No doubt the relative humidity at Wilmington is somewhat higher, but the difference is not great.

A personal examination of the stocks thus handled has convinced the writer that less aeration would result in better forcing stocks. No opportunity has been presented to test these stocks in comparison with those handled differently, but an examination showed that the bulbs dried badly. Excessive exposure is also the rule in California, where stacked trays of bulbs are sometimes left in the open for weeks.

The conclusion is forced that the storage handling of these bulbs should be carefully attended to and not be very different from that advised for tulips. The surface should be dried off not necessarily promptly but without serious delays and without heating. The ventilation should then be decidedly reduced, so that the bulbs do not dry out too much.

As to temperatures, the conditions are also about equivalent to those for tulips. A cool situation for the region seems to suffice. This simply means that warm, stuffy, poorly-ventilated rooms or attics close to metal roofs and similar situations should be avoided as storage spaces for these bulbs. Of course, it is understood that varieties of the English group are to be kept out of the soil as short a time as possible, for they are not adapted to a warm climate at all.

CLEANING THE BULBS

The economic importance of the matter of handling the bulbs after they are dug, subsequent to drying and preparatory to planting or

selling, can be thoroughly appreciated only by those who have had experience in handling the stocks. The operation of cleaning may be exceedingly burdensome or it may be almost negligible, depending entirely on a difference of a few weeks in the time of digging.

At the Bellingham garden the operation of cleaning the iris crop of débris, old tops, and husks subsequent to digging has always been a burdensome and tedious proceeding because the crops blossom and mature late and because of the necessity of getting the planting done by September 1.

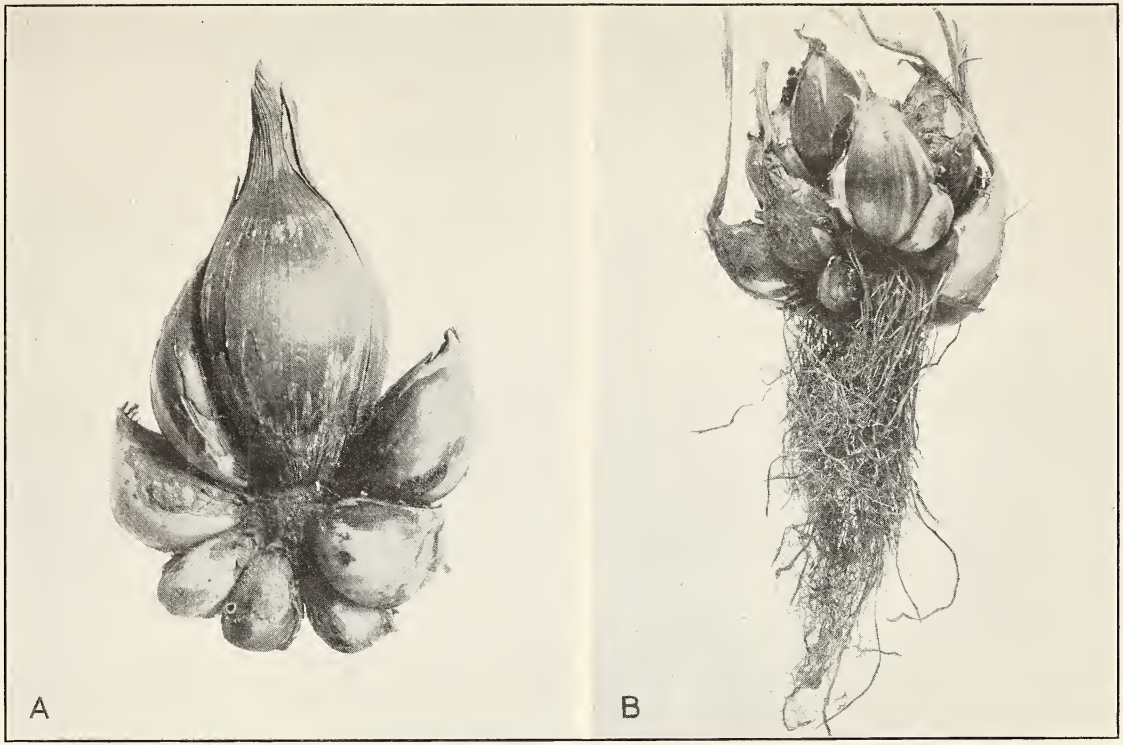
The blossoming takes place about the middle of July. The seed is ripe enough to grow about August 10, when the bulbs have been lifted, the xiphiums first and the English forms later. At this season the tops of the xiphium groups are dead and dry except possibly the stem bases. Often, however, the English forms are dug while the stems and occasionally some of the leaves are still functioning somewhat.

When dug under these conditions the old stems and leaf bases are very difficult to remove. They are stringy and nearly as tough as raffia and must be pulled a certain way in order to come off at all. Under these conditions there is danger also of injury to the bases of the big bulbs, necessitating more care than is compatible with needful speed in economic handling.

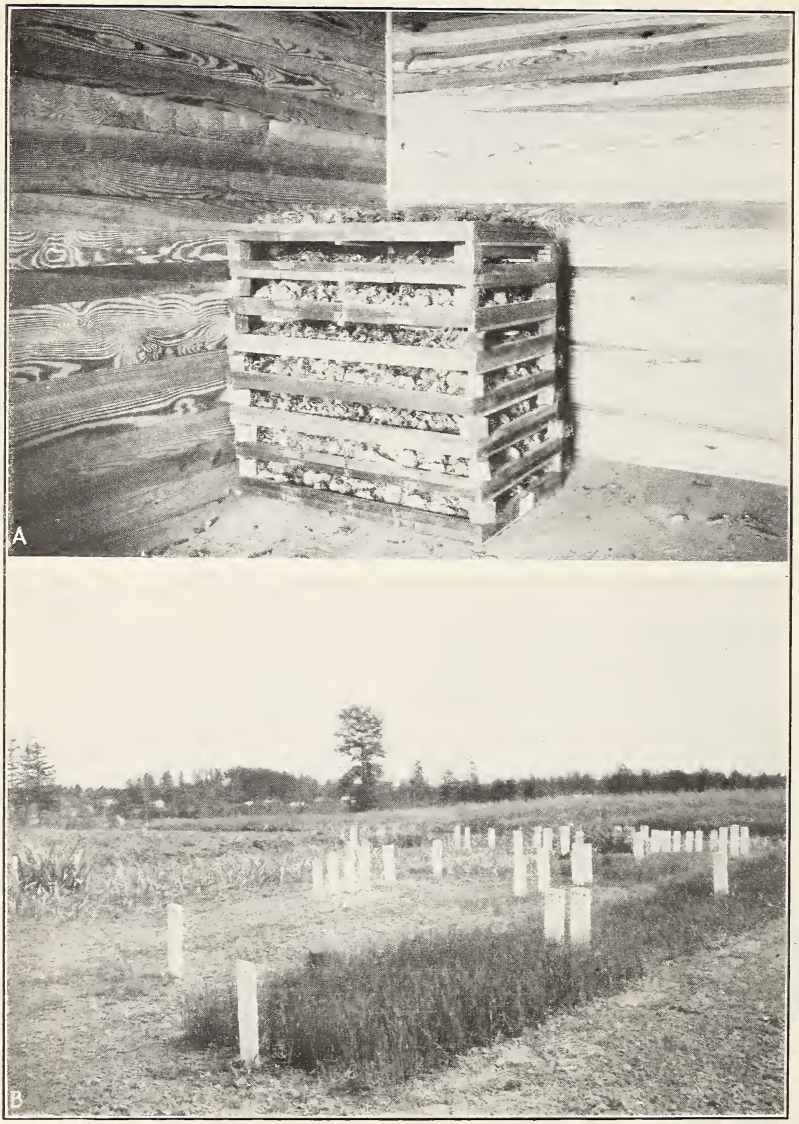
At the Arlington farm and the Coastal Plain station at Willard, on the other hand, cleaning the bulbs has never meant much in labor cost, because in these localities the bulbs are dug in mid-July and in mid-June, respectively, after the tops have become dead and their underground portions somewhat disintegrated. Under this degree of ripeness the stem comes off readily when simply bent to one side, and all the old husks which need to be removed have disappeared or are easily pulled off. All the labor involved in the cleaning under these conditions consists in removing the old stems and breaking off the increase, both of which are easily accomplished without injuring the bases of the large bulbs.

The operation of cleaning is very similar to the comparable one in handling tulips, daffodils, and other Dutch bulbs. The preferred way is to spread the dry stocks on a table. The bulbs with the old husks attached are then picked up in small handfuls. The stems are broken off by being bent sharply to one side, the offsets are rubbed off, and the large bulbs are taken out, preferably by hand, and put into containers to be returned to the shelves. Or all the bulbs are allowed to go back on the table, this operation simply consisting of breaking the clumps apart and removing the coarse débris from the mass.

The efficient workman will usually spread out on a clear space before him on the table a good handful of bulbs from the pile as dumped from the trays and do the necessary work on it. This accomplished, all the bulbs will be shoved to one side and another handful pulled off the pile. When the tableful has thus been gone over, the pile of bulbs is shoveled into containers and taken to a grain-fanning mill slightly modified in screen and draft to handle this kind of material. This machine removes loose particles of soil, loose light husks, etc., and leaves the bulbs clean and ready to be returned to the shelves for storage.



A.—Normal bulb of *Iris tingitana* with attached reproduction
B.—Bulbs of the Dutch iris David Teniers resulting from one first-sized bulb left undug for two years



STORAGE AND SEEDLING DEVELOPMENT OF BULBOUS IRIS

A.—Storage of Dutch iris bulbs on stacked trays at the Coastal Plain Substation, Willard, N. C.
B.—Seedlings of English iris in the foreground. The seed was sown the last of August as soon as gathered. Photographed May 1 following

This is essentially the method of operation at Bellingham, Wash. In the other situations, where the quantities of material handled have been smaller, no blower has been employed. The cleaning there is done in a screen-bottomed box, which, owing to the greater disintegration of the coverings and tops, gets rid of most of the débris automatically.

NATURE OF THE PLANTING MATERIAL

The size of bulbs planted is very variable, depending upon many factors such as the character of the previous year's planting stock, the nature of the soil, its fertility, the necessity for increasing or decreasing the planting, and the closeness of the turn-off.

The most advantageous planting stock is that in which a maximum number of bulbs will reach marketable size with only one year of culture. Since the round bulb is the best merchantable one, the next season's turn-off will come from the largest of the current season's offsets together with small round bulbs grown one year from the smaller propagation of the previous season.

Round bulbs which have not blossomed produce some bulblets, but these are usually not so large as those produced by first-size bulbs, most of them requiring two years of culture to reach maturity. The number produced by the round bulbs as compared with those produced by the flowering sizes is about as three to six. Even this gives a very fair increase, and with care in planting this is often sufficient to maintain stock for a time. It is more than likely, however, that quality will be run down unless the best stocks are reserved for planting. It seems to the writer to be just as necessary to use the best bulbs of iris for seed stocks or for propagation as it is in the case of tulips, daffodils, or any other nursery material.

All of this relates to the xiphiums. It is a little different with the English iris group, and they must be considered on a different basis. The quantity of these used is comparatively small, as they are used for outside plantings only. Here also moderate-sized bulbs are advantageous for planting stocks, but for slightly different reasons. As has been seen, it seems preferable to ship without removing the offsets in a medium-sized tight clump, as described on page 12.

PREPARATION OF STOCKS FOR PLANTING

With the stocks of the xiphiums and their allies cleaned and on the shelves, the main preparation for planting consists in sizing the bulbs so that there may be a better distribution of plant material on the ground and so the sizing for the market next season will be more easily done. This is satisfactorily accomplished by the use of the conventional nesting sieves with perforated rawhide or laminated-wood bottoms. A nest of four will make five sizes.

These nests so arranged may be used in various ways. In the operations at Bellingham the nest is set in a shaker illustrated in the writer's bulletin on tulips.[1] Each sieve catches one size of bulbs, and the smallest size passes in this case through the lower 5-centimeter openings into the pit below the nest.

[1] GRIFFITHS, DAVID. THE PRODUCTION OF TULIP BULBS. U. S. Dept. Agr. Bul. 1082, 48 pp., illus. 1922.

At the Arlington farm and at Willard, N. C., where these stocks are grown, the sizing has not been so accurate. Commonly but two sizes have been made, and this has been done by hand picking the largest bulbs, the remainder all going into the second size.

In the past at Bellingham the sizes made have been mainly four in number. The first size has been those caught by an 8-centimeter sieve; the second, by a 7-centimeter sieve; the third, by a 5-centimeter sieve; and the fourth, all the bulbs smaller than 5 centimeters. At times, owing to large quantities of small clods and gravel among the bulbs, the smallest size has again been run over a ⅜-inch wire mesh which removed most of this débris and also the very small bulbs. No attempt has been made to save the latter, as it is found that when planted at the normal depth of 4 inches few of them come up.

SPACING AND DENSITY OF PLANTING

It has been the practice to plant bulbs above 8 centimeters mostly 11 to the row,[2] those 7 to 8 centimeters in size 14 to 21 to the row, those 5 to 7 centimeters in size about 35 to the row, and the smallest 50 to 100 to the row. Only bulbs of the largest size are set upright, the remainder being strewn along in any position.

In practice it is found that there is a decided advantage, both in economy of space and in labor, in planting the small sizes very thickly. The same advantage occurs here as in growing the cormels of gladiolus, which the best growers are planting so that they come out of the ground in a continuous matted mass across the bed when dug. So far as observed, they make as good growth at 75 to 100 to the row as they do when scattered along thinly, provided, of course, that the fertility is sufficient to maintain the heavy crop.

MERCHANTABLE BULBS

The market demand is for a round bulb as distinguished from a flat one. It is also true that the bulb which the market wants is one which has not flowered, but will give its first flower the next year on the florist's benches or in the householder's garden. It is sometimes said that the reason round bulbs are preferred is that the first flower and the best one that the iris bulb produces comes from a round bulb, but the writer has not found this reason to be particularly forceful. Indeed, there does not seem to be much difference between the flowering of round and flat bulbs of equal weight and quality. Other reasons for these market preferences are therefore to be looked for.

The advantages of a round bulb over a flat one seem to consist in its better coating, better appearance, better and less easily injured base, and, on account of these characteristics, better construction to withstand mechanical injuries which give opportunity for the ingress of mites and molds on the shelves, in the pack, and later in the flats and pots.

Experience in these investigations seems to indicate that the large bulbs which have flowered perform fully as well as the round ones

[2] The rows run across a 3-foot bed and are 6 inches apart.

which have not flowered, provided they are in no way injured before potting, but it is much more difficult to keep and deliver them in that condition. Consequently, the round bulb is the advantageous one to put on the market.

It is really surprising what a difference there is in the carrying qualities of flat and round bulbs. In 1926 an opportunity was presented to observe this in a very definite way when the stocks of four Dutch varieties and of filifolia Imperator iris were shipped from Bellingham, Wash., to Washington, D. C. They were sized and graded into different categories before being packed and were then put up in similar packages and forwarded in the same case by freight. Delivery was made in Washington in a little less than four weeks, and examination took place at potting time 10 days later.

When packed, all of the bulbs seemed to be in perfect condition. The stocks had been dried out fairly well before cleaning and had been allowed a subsequent airing for 10 days on the shelves in order to dry and heal the broken surfaces. In spite of this care, the flat bulbs in all varieties showed considerable injury on being unpacked, some as high as 10 to 12 per cent, whereas there was almost no loss in round bulbs of any lot.

In the separation of the offsets, 4 to 8 in number, from the mother bulb at cleaning time there occurs, as previously noted, considerable freshly broken tissue on the more or less elongated base. (See pl. 1, A.) This is not all. Often, really more often than not, this projecting base is broken off, making one large scar close to the scale bases, leaving a very thin basal plate and a large, raw wound. It is this condition, together with poorer coating, that is primarily the cause of so much more loss in flat than in round stocks. The flat bulbs invariably carried much better when the projecting base was intact than when broken off.

In the forcing of the past season those flat bulbs which flowered at all—that is, those which did not rot—produced flowers averaging as good as those from the round bulbs.

The sizes which should go on the market will vary considerably with the variety, but the variation is very much less proportionally than in the tulip or the daffodil. The Dutch bulbs are larger than the Spanish; next in size come those of *Iris filifolia* Imperator; and the largest of the xiphium group are those of *I. tingitana.* The bulbs of the English iris are still larger. Bulbs of some of the Spanish group will blossom with certainty when 6 centimeters in circumference. Seven centimeters is a safer size for the Dutch groups. *I. tingitana* should have 11-centimeter bulbs to flower well. Blossoming will occur in the English group from about 11 centimeters upward.

PACKING AND SHIPPING

As with other bulbs, the secret of success in the transportation of the bulbous iris is good aeration of the pack. A big bulb mass, the center of which is inevitably poorly aerated, must be avoided, so that there will be no accumulation of moisture, development of heat, root action, growth of molds, and consequent decay.

A small mass in the pack is therefore necessary for successful carriage. This is accomplished in various ways. If shipment is made in bulk, the crate should be narrow in one dimension. A broad,

flat, slatted crate is the most suitable. Another method of accomplishing the same purpose is to use a larger crate, break up the mass by putting the bulbs in heavy, preferably perforated, paper sacks, and packing these tightly in the case. These sacks may hold 100 to 500 bulbs, and a dozen or more of them may be packed in the crate. It is always advisable in any form of protection to pack the case tightly so that the load does not shift, and so prevent mechanical injury.

All this applies mainly to the handling of the xiphiums, for they are the ones that will be shipped in large quantities, necessitating care in avoiding what may be termed mass effect. The English varieties will be handled in much smaller quantities, but they are even more subject to injury in transit than the xiphiums.

The main reason for the restricted use of English iris forms in gardens has been the difficulty of shipping them from foreign countries. So difficult has it been to get them from Europe in good condition that the Dutch salesmen had practically ceased to handle them before the war. The experience of the Bureau of Plant Industry in their importation is significant and no different from that of the many firms who used to import these most handsome varieties. In 1917 the writer was instrumental in importing 17 varieties of English iris which were inspected in Washington, D. C., and then reshipped to Bellingham. The bulbs were in such bad condition upon arrival that the men who handled them hesitated to plant them, but 15 out of the 17 lots were saved. In some cases a stock of 250 to 500 bulbs dwindled by the end of the first growing season to a dozen small, nonflowering sizes. Such has been the general experience, and the impression has sometimes been that the bulbs are diseased, but this is not usually the case. The trouble is that they are bad shippers, are easily bruised, and do not keep well out of the ground. All the bulbs that grew out of this importation were in perfect condition at the end of the first growing season, and there has been no difficulty in working up clean, healthy stock from what was saved.

Although the conditions above described are discouraging with reference to imported stocks, no difficulty has been experienced in shipping experimental stocks from the Puget Sound region to the East and holding them in ordinary storage for a month or six weeks, provided thorough aeration was always maintained and the bulbs were not bruised.

In retail shipments it may be advisable to wrap the bulbs separately in paper and pack tightly in paper cartons to prevent bruising. This method may be especially applicable to fine stock and large bulbs.

As with the Spanish and Dutch groups, the best bulb of English iris to send the customer, all things considered, is the one which has just reached flowering size, but this may be slightly flattened by the production of the side bulblets. Unless extreme care is used in handling it will probably be found vastly safer to ship the English iris bulbs with whatever bulblets they may have attached, for the bulbs are very prone to mold at the points where the bulblets are broken off, and when these bulblets are removed it is common for the base of the main bulb to be broken also. Even when such is not the

case, the base is long and likely to be injured in packing, so that on the whole the bulbs keep and ship with less difficulty when the reproduction is left attached.

In the English iris it is also desirable that a minimum of cleaning be given. The stocks to be shipped are better if none of the old husks (leaf bases) are removed. They are better protected if the old leaves are simply clipped off with shears.

The bulbs of the English iris are fat and plump. Their delicate live tissues are easily exposed and still more easily abraded. Any injury to the live tissues of the scales furnishes the most fertile location for the development of molds which start decay. It is believed that the best plan in the handling of these iris stocks is to demand a price commensurate with the extreme care necessary to get them to the consumer in perfect condition. This can not be a burden, for the quantity purchased by an individual will be small and infrequently made. With the xiphiums, however, the case is very different, for the production must be on a quantity basis, and the prices must be such that the forcer and the retailer can make a profit in order that an industry of growing may be built up.

Various materials, such as grain chaff, ground cork, ground peat, and similar substances, are sometimes used to sift in between the bulbs in the pack, but most of the Spanish and Dutch varieties are shipped without packing materials. In domestic express shipments, especially where the bulbs are in transit but a week, such materials are not considered essential. Good aeration in the pack is all that is necessary if the bulbs are in good condition when they start. Even in slow freight shipments the aim should be to reduce the size of the mass rather than to make it more dense. In shipping the Dutch varieties from Bellingham, Wash., to Washington, D. C., the conventional perforated paper sacks, each holding about 250 first-size tulip bulbs, packed 16 to a slatted, well-aerated crate, have carried without loss.

Some European growers have at times sprinkled flowers of sulphur among the packed bulbs. This is of some benefit in reducing the development of molds and possibly mites, but a pack which furnishes conditions in which molds can develop, or bulbs in which mites are prevalent, will neither ship well nor give satisfaction on arrival. It is much safer to make the conditions right than to attempt to correct faulty ones by the use of chemicals.

WHERE THE BULBS CAN BE PRODUCED

The xiphium groups, except *Iris tingitana*, are very adaptable and can be produced under widely varying conditions. Experiments indicate successful culture on Puget Sound, along the Potomac, and on the northernmost of the southern sands in the latitude of the Carolinas. Commercial successes are chronicled for the entire length of the Pacific coast, Long Island, Virginia, Illinois, Michigan, and Tennessee, which is a wide enough range of conditions.

In all probability it will be found that the most economical production of these bulbs will be possible in a mild but not excessively warm region. There does not now appear to be much hope of success with them along the Gulf coast, if judgment is to be based upon trials which have thus far come to notice. In these warm regions the

bulbs are badly attacked by mites and have nearly all failed within two years. Excessively cold regions, especially if there is a lack of snow or other protection, on the other hand, are also dangerous, owing to the fact that the stocks go through the winter in vegetative condition. Although the bulbs stand a great deal of freezing, the limit is frequently reached, more particularly with some of the Dutch varieties than with the Spanish, it is said, while *Iris tingitana* can be grown only in a strictly mild climate. So far southern California seems to be best adapted to this uncertain and difficult plant.

The English-iris group is adapted to a cool, moist condition. It is perfectly at home in the Pacific Northwest, particularly in the Puget Sound region, where moisture never fails from September to June. On the more retentive soils there is usually sufficient moisture to carry the plants through to early August flowering and late August or early September maturity. The almost total absence of rain from the midde of June to late August, however, cuts the crop somewhat short in dry years, but not seriously.

While failure rather than success is usually chronicled for the English iris in the eastern United States, there are a sufficiently large number of successful experiences to justify the prediction that when these varieties are given faithful trial with good, well-preserved bulbs success will be the rule throughout the northern tier of States. A number of successes are known in Massachusetts and New York, mainly with the common blue variety.

The writer's experience at Washington, D. C., is not reassuring. Good flowering occurs the first year from bulbs brought in from Puget Sound. The second year the plants are dwarfed and the flowers are smaller, and the third year little is left. These attempts at Washington have been made on a heavy clay fill, however. Better soil conditions with more constant moisture and a little shade might produce better results.

Recently one cooperator at Santa Cruz, Calif., after four years of effort, has been able to dispose of a little stock of locally grown English iris. In the writer's opinion, this region is rather warm and dry for them during the summer months. Better successes are to be looked for from Eureka, Calif., northward.

SEEDLING CULTURE

It is a matter of common knowledge that both xiphium and xiphioides iris varieties are subject to "breaking," as described on page 17. The English varieties are proverbial offenders in this respect. Both plants and flowers of most imported stocks are more or less mottled. A seedling generation from these broken plants is clean and pure in both vegetative and floral coloration. These seedlings are also more robust and attractive than any of the 15 or more varieties imported by the Bureau of Plant Industry from the best European sources.

When the attention of foreign bulb salesmen has been called to the superior characters of seedlings they maintain that these will also break. But if, as is now suspected, this breaking is a virus disease and the old broken stocks are eliminated, allowing no chance for infection, the seedlings must remain pure in color, since the source of infection will thus be eliminated also. It is significant that these seedlings remained pure in color when grown beside the old broken

stocks for five years before they began to break. Insects are rare on these bulbous irises at Bellingham, Wash.

It is also significant that there are a few forms of English iris which have existed in gardens in the Puget Sound region for many years. Some of these are of pure unbroken color. It is believed that if unbroken stocks can be established they will remain so if the broken ones are eliminated.

With the remarkable development that has been made in the rhizomatous section of iris by the American breeders, there is every reason to believe that just as promising a field of accomplishment lies before them here when attention of breeders is turned vigorously toward the improvement of these bulbous groups. Enough has been done at the Bellingham garden and by E. O. Orpet at Santa Barbara, Calif., with the Dutch group to show that this is a fertile field for experimentation.

This is not all. The rhizomatous sections which have occupied the attention of iris fanciers in this country so largely are garden forms only and limited in applicability by that very fact, while the xiphium groups are an important florist stock, which, if produced in good quality and bred to even better varieties, would be utilized as soon as they are sufficiently available in a score of millions. There is no field so promising to-day in practical commercial results in iris breeding as the xiphiums. It is hoped that breeders will turn their attention to these bulbous irises for the following purposes: (1) Developing unbroken varieties, (2) improving form and color, (3) producing earlier varieties by the use of the earliest forms that now exist, and (4) introducing other more tractable blood into *Iris tingitana*, thereby producing hybrids more amenable to both cultural and greenhouse handling.

There is need of a survey of the native habitat of *Iris filifolia* and *I. tingitana* in northern Africa for other forms which may give elements of value for the breeder, if, indeed, some forms may not be found superior in themselves.

In spite of all the excellent work done by the Dutch breeders, the bulbous groups are looked upon as being capable of improvements as striking as those wrought in the common garden iris in the United States in the last 15 or 20 years.

PROPAGATION

The natural propagation in both xiphium and xiphioides groups is very similar to that of the tulip. The formation of bulblets is from buds on the basal plate of the bulb planted, but the reproduction is bilaterally symmetrical in one plane, there being one to four bulblets on each side of the main bulb which develops from the bud nearest the center. The old bulb is all used up in the stem formation, and entirely new bulb structures are formed from the buds in the axils of its scales.

Such of the xiphiums and their allies as have been grown, representing rather well the Spanish and Dutch groups at Bellingham, Wash., and *Iris tingitana* at Chico, Calif., have all produced seed rather sparingly, the yield ranging from none to about a dozen viable seeds in an occasional pod, but the number is very variable, and the pods are never filled. The English or xiphioides group,

on the contrary, produces seed very freely. Practically every pod is filled with well-developed viable seed without any artificial pollination.

There is no difficulty about growing the seed of either group, but it should be remembered that planting is better done before it gets thoroughly dry, and on Puget Sound preferably soon after gathering in late August. If this is not done and the seed is held over for spring planting, it will lie in the soil a whole year and then come up with unabated vigor, but of course with the loss of a year in time.

The favorite method of handling the seed of bulbous iris at Bellingham is to plant it in beds in late August, as soon after it is ripe as possible. It is dried only enough to make it shell easily and then planted thick, 1 inch deep, in rows 3 inches apart. (Pl. 4, B.)

Such a planting is not disturbed for two years. At the close of the first growing season it is well to add an inch of soil to insure sufficient depth for protection of the young bulblets the first winter. At the end of the second growing season the bulbs are large enough to handle nicely. They may then be dug, reset, and given about four times as much space, then left for two more years, and dug and spaced again. A few flowers appear the third year, but there are plenty of them the fourth. Indeed, if not too thick and if well grown, all the seedlings should blossom the fourth year under entire out-of-door and open-field culture.

VEGETATIVE HABITS

All of the xiphiums and their allies appear above ground very promptly after they are planted, the tops and roots developing simultaneously. They therefore go through the winter in vegetative condition of different degrees of advancement, depending on date of planting, lateness of season, or length of season in the locality. The English varieties remain below ground until spring.

The xiphiums have a long period between the beginning of top growth and the appearance of the stem, while the English varieties have a short one, the stems in the former appearing but a month in advance of the latter, while there is a difference of four or five months in the appearance of the leaves.

The root systems of the two groups are very different. The xiphiums and their allies are strong rooters with systems as copious as those of the tulip. The English varieties, on the contrary, have such a paucity of roots as to create the impression that there must be something wrong with them. In a friable soil it is possible to pull a large percentage of bulbs of the English group out of the ground by merely a slight pull on the tops.

ENEMIES

The bulbous iris varieties are remarkably free from serious pests. However, there are a few enemies which, if neglected, are capable of doing a great deal of injury. Those which have been dealt with in these investigations are enumerated below.

The tulip bulb aphis.—The bulb aphis (*Anuraphis tulipae* Boyer) does most of the damage to the bulbs in storage. The neglect of the growers in combating it in California has been responsible in a large measure for the failures ex-

BULBOUS IRIS UNDER GLASS

A.—Dutch iris Albert Cuyp grown at Bellingham, Wash. Forced at Arlington Experiment Farm
B.—Dutch iris Rembrandt grown at Bellingham, Wash. Forced at Arlington Experiment Farm

perienced in the early culture of the bulbous iris on the Pacific coast. The control is simple. A thorough dusting of the storage shelves with any of the finely ground fresh-tobacco products will rid the bulbs of this aphis.

The bulb mite.—The bulb mite (Rhizoglyphus sp.) is at times quite troublesome. It accumulates in the pack and in storage, where the havoc wrought is serious under warm conditions, long storage, and poor aeration, especially if accompanied by rough handling. Probably the most effective remedy is the hot-water treatment. The treatment which has proved effective in these experiments has been 90 minutes' immersion at a temperature of 110°. The killing was apparently complete. This treatment also kills the aphis.

Sclerotium semen.—The Sclerotium fungus is very likely to appear in a pack which heats and develops moisture. At times an entire case will be matted together with the mycelium, and the sclerotia, ranging from white through brown to black, may be formed thickly over the bulbs. The remedy is obvious. The appearance of such a conspicuous fungus is likely to cause alarm, but the simple prevention of heating by good aeration remedies the condition and prevents the rotting.

Dry rot.—When bulbs of the xiphium iris have been bruised, the tissues become dried out and chalky. If the bulbs are piled up and poorly aerated this chalky area spreads to surrounding bulbs until the whole pack is involved. At first the tissues soften, but they finally dry out into a powdery mass.

Rodents.—Mice, moles, and pocket gophers, in the order named, do a great deal of injury to iris bulbs. The mouse is most destructive and operates in both field and storehouse, and the other two operate in the field only. The mole in the Northwest not only makes runways which mice occupy, but it destroys bulbs by feeding on them and by cutting off their roots in its meanderings through the soil. For information on the control of these rodents the reader is referred to publications of the Bureau of Biological Survey of the United States Department of Agriculture.[3]

Wireworms.—At Bellingham, Wash., there is always more or less injury from larvæ of the click beetles, but it has not been so serious as in some regions farther south. The injury at Bellingham has consisted of holes one-eighth inch deep in possibly 1 or 2 per cent of the bulbs.

Breaking.—Any of these irises may become mottled in both flowers and foliage. All such mottling, however, does not appear to be of the nature of a mosaic disease. Sometimes suitable cultural conditions eliminate certain mottlings, while others seem to be permanent.

The department's clean stocks of Dutch varieties became mottled in two years when grown in southern California, but they maintained their purity of color in Oregon. The California stocks recovered their purity of color with two more years of culture on Puget Sound.

The breaking in the English iris stock imported in 1917 seems to be permanent. The whole subject needs careful study, for it is little understood. See page 12 for further discussion.

YIELDS OF BULBOUS IRISES

Yields per acre in the xiphiums and their allies are phenomenal. Even in *Iris tingitana*, which has comparatively large bulbs, the number which can be grown on a given area is very large, although not so large as in the smaller bulbed Dutch and Spanish groups.

Under the conditions obtaining at Bellingham, where the Dutch bed method of culture is practiced, it is estimated that bulbs planted 21 to the row should all be ready for the market with one year's culture. About half of those put in as 35's, and even a small per-

[3] SILVER, J. MOUSE CONTROL IN FIELD AND ORCHARD. U. S. Dept. Agr. Farmers' Bul. 1397, 14 pp., illus. 1924.
SCHEFFER, T. H. AMERICAN MOLES AS AGRICULTURAL PESTS AND AS FUR PRODUCERS. U. S. Dept. Agr. Farmers' Bul. 1247, 23 pp., illus. 1922.
UNITED STATES DEPARTMENT OF AGRICULTURE. BUREAU OF BIOLOGICAL SURVEY. DIRECTIONS FOR POISONING POCKET GOPHERS. U. S. Dept. Agr. Bur. Biol. Surv. Mimeographed Circ. Bi–175, 3 pp., illus. [n. d.]

centage of the smallest size, under 5 centimeters, should blossom after one year's growth.

If the comparison is made by weight, the yield is more readily appreciated and gives a better basis of measure. The actual performance in the experimental plantings at Bellingham, Wash., will serve as an example of a normal yield for the varieties listed. (Table 1.)

TABLE 1.—*Yields of Iris xiphium and allies in experimental plantings at Bellingham, Wash.*

Variety	Planted in 1925	Harvested in 1926	Variety	Planted in 1925	Harvested in 1926
	Pounds	*Pounds*		*Pounds*	*Pounds*
Tennessee native [1]	9	24	David Teniers	44	110
Filifolia Imperator	15	33	Rembrandt	37	95
Anton Mauve	33	89	Albert Cuyp	34	105

[1] A variety commonly grown and referred to as a native iris about Knoxville, Tenn.

In explanation of Table 1 it may be said that in 1925 no bulbs above 7 centimeters in circumference were planted, except in *Iris filifolia* Imperator, in which nearly the whole stock was planted back and many of the larger bulbs failed, lowering the yield proportionally somewhat below that of the other varieties. No weights were taken in North Carolina, but it is believed that fully as good results were obtained.

No effort has been made to get yields in weight of the English group, but it can be said with confidence that if the moisture supply is sufficient from June to August the yield is even larger than in the xiphiums.

MOISTURE REQUIREMENTS

For any satisfactory results in field, pot, or garden, these irises must have a constant and abundant supply of moisture at their roots during the growing season. Any shortage even of short duration is inimical to good production of either flowers or bulbs. On the other hand, there is a great difference in the seasonal moisture requirements. All except the English varieties revel in a dry, warm situation from early summer to fall, *Iris tingitana* requiring the most heat and being a failure without it. The English varieties, on the contrary, mature later and must have moisture prolonged farther into the summer season.

GROWING UNDER GLASS

All the groups considered here, except the English varieties, are greenhouse subjects, but they are never forced hard. They all blossom well, however, when brought along slowly without high heat, and all except *Iris tingitana* (which is early) are adapted to February flowering.

The bulbs are small and the leaves are narrow, consequently planting can be thick, 75 to a standard flat of all but *Iris tingitana*. On account of the precocious top growth the pots and flats should not be buried, but should simply be plunged to ground level in the open or

in frames and allowed to develop naturally from the time they are set in September until danger of hard freezes. They should then be brought to the benches of a cool house and carried preferably at 45° to 50° F. at night until the middle or last of January, when an increase of 5° of night temperature may take place for February flowering. If flowering is desired a little earlier, an earlier subjection to the higher temperature mentioned will prove safer than subjecting the stocks to a higher heat than 55° F. at night. (Pl. 5.)

The Spanish, Dutch, and Imperator groups are particularly advantageous forcing subjects on account of their certain performance, popularity, beauty of their flowers, and economy in the matter of space required for their forcing. They require but half the space of tulips and a third of the space of daffodils.

The case of *Iris tingitana* is very different. As previously stated, it has always been uncertain in its performance. Imported bulbs have commonly proved to be unsatisfactory, and failures rather than successes have been the rule with them.

When good stocks are used and the bulbs have ripened well with a long, dry summer, it is possible to get good results and flower *Iris tingitana* by New Year's. However, it is not profitable to subject it to high temperature at any time during the forcing period.

The actual behavior of Bellingham-grown xiphium bulbs under a given treatment in the winter of 1926–27 may be useful as a suggestive guide to the handling of these stocks. Four Dutch varieties were planted on October 5 and set outside on the surface of the ground for 21 days, when, on account of the danger of cold weather, they were put on the benches of an unheated greenhouse. There was a top growth of 3 or 4 inches when the stocks were brought in. As the weather cooled a little, heat was applied to maintain a temperature of 45 to 50° F. at night until December 26, when an increase ranging from 50 to 55° F. at night was made. The plants began to blossom in early February and were at their best from February 15 to February 25.

It should be noted that this stock was grown at Bellingham, Wash., and consequently was later flowering than if grown at Portland or farther south or on the Atlantic Coastal Plain. The same varieties, grown in North Carolina, potted 10 days later and otherwise handled the same, came into blossom a few days earlier.

THE COMMERCIAL VARIETIES

One of the most reliable of the Dutch growers in his 1927 catalogue lists 21 varieties in the Dutch group and 39 in the Spanish group. The 1926 list of the same grower contained the same Spanish varieties and more than twice as many of the Dutch, showing an early elimination by this grower of unnecessary sorts in this comparatively new Dutch class.

Since lists of varieties of bulbous iris in the groups considered here are not generally available to the growers, it is thought that such lists of the regular 1927 offerings will be serviceable. These are accordingly appended, each name being followed by a brief characterization which will assist in its recognition.

SPANISH VARIETIES

Bazaine—bronze.
Beauty—porcelain blue.
Belle Chinoise—yellow.
Blanche Superbe—white.
British Queen—white.
Bronze Queen—terra cotta.
Cajanus—yellow.
Captain of the Blues—dark blue.
Chrysolora—pale yellow.
Empress of the Blues—blue.
Excelsior—light blue, very late.
Flora—white and lilac, early.
Golden Lion—dark yellow.
Golden Prince—golden yellow.
Golden Wonder—canary yellow.
Grand Maitre—light blue.
Heavenly Blue—deep sky blue.
Hercules—dark bronze.
King of the Blues—blue.
King of the Whites—white.
King of the Yellows—dark yellow.
La Citronniere—lemon yellow.
La Nuit—dark blue.
La Reconnaissance—bronze.
La Tendresse—white and yellow.
Leander—deep yellow.
L'Honneur d'Overveen—blue.
L'Innocence—white.
May Flower—deep blue.
Miss May—light blue.
Ouida—blue.
Prince Henry—bronze.
Queen Wilhelmina—white, early.
Raphael—blue.
Royal Blue—marine blue.
Surbiton—dark yellow.
Sweetheart—creamy white.
Thunderbolt—yellow and bronze.
Wouwerman—orange yellow.

DUTCH VARIETIES

A. Bloemaard—dark blue.
A. L. Koster—white.
Adrian Backer—purple lilac.
Arie Scheffer—dark blue.
D. Haring—white.
E. B. Garnier—dark blue.
Hackaert—blue with dark-yellow blotch.
H. G. Pot—lilac with light lilac falls.
J. Victors—blue.
J. W. de Wilde—dark yellow.
Leonardo da Vinci—lemon standards and yellow falls.
P. de Moolijn—dark blue standards with blue falls.
Poggenbeeck—dark blue.
Rembrandt—blue with large yellow blotch.
S. Rombout—blue.
Therese van Duyll (Schwartze)—lilac standards and white falls.
Th. Wijck—light blue.
W. de Zwart—white, suffused lilac, yellow blotch.
Yellow Queen—yellow.

ENGLISH VARIETIES

Adelina Patti—white with faint blue stripes.
Bavaria—white with pale blue standards.
Bleu Celeste—sky blue.
Couleur Cardinal—dark blue.
Duke of Richmond—magenta purple.
Electra—pale blue.
Enchantress—porcelain.
Frans Hals—porcelain with rosy purple.
Grand Lilas—light blue, spotted.
Hugo de Groot—blue, purple standards and white on lower petals.
James Dewar—china blue.
John Ducker (Koh-i-noor)—white, mottled with rose purple.
King of the Blues—deep blue (pl. 6).
Lilacea—lilac, striped.
Lord Derby—blue, striped.
Montblanc—white.
Mrs. Barclay—white, spotted.
Nimrod—violet, tinted purple.
Othello—magenta purple.
Penelope—white, rosy spotted.
Perle des Jardins—light blue.
Philomena—china blue with white blotch.
Princess Dagmar—creamy white, spotted.
Prince of Wales—dark blue.
Rosa Bonheur—white-splashed carmine.
Rousseau—bright blue.
Ruby—deep violet.
Sunset—lilac, striped.
Surprise—indigo.
Thackeray—claret.
Trafalgar—porcelain spotted.
Vainqueur—light blue.
Viceroy—rosy white, spotted.

TINGITANA VARIETIES

Tingitana—light blue.
The First—dark blue.
Princess Juliana—doubtfully distinct from type.
Wedgewood—light blue.

FILIFOLIA VARIETIES

Imperator—dark blue.
Celestial—sky blue.
White Excelsior (Voerman)—white.

THE CUT FLOWER

One of the main obstacles in the accumulation of stocks of the xiphium group of irises has been their popularity as cut flowers. This may seem paradoxical, but when one reflects that the price of the cut flowers during the last 10 years has often been twice that of the bulbs, which have themselves been high, and that the demand has always been in excess of the supply, it is not to be wondered at that growers have sold their flowers without reference to the effect on the bulbs.

Another cause of demoralization has been the attempt in some cases to harvest two crops, one of flowers and the other of bulbs. The entire flower production has been cut for the flower market in spring and early summer, and two months later the crop has been dug and the best of the bulbs, those of flowering size, have been culled out and put on the market. Other growers, finding that there has been a great deal of complaint regarding their bulbs when forced, have taken the path of least resistance by abandoning all attempt at sale of bulbs and have confined their attention to the cut-flower market, thus using these varieties for out-of-door cut flowers rather than forcing stock for late winter use. The whole matter is in flux, but with the large importations which have been made and the constant accumulation of information regarding the requirements of the crop it is more than probable that a balance will be attained soon and that an adequate supply of merchantable stock will be available. The great demand for the cut flowers from the field, however, is a potent influence in keeping down supplies of suitable bulbs for winter forcing.

There are few flowers that equal these so-called poor man's orchids (*Iris xiphium*) as cut flowers. The carrying quality is superb. It is possible to ship them across the continent in mail packages and have fairly good delivery. Shipment from either coast to Chicago is commercially practicable.

In order to insure best delivery and longest usefulness after arrival, the cut is made in tight bud. The packing is then easily accomplished, because the buds occupy but little more space than the stems and consequently are not so easily bruised as are flowers cut after opening.

The best plan is to stand the stems in water for a few hours and then pack and ship the buds comparatively dry and wrapped in oiled paper.

The exact stage at which buds are cut may be varied to conform to the length of time of shipment. If the flowers are to be used in 24 to 36 hours, the cut should be made when the bud is out of the sheath, but for later use or long shipment it should be made when only about one-half of the flower bud is exposed. (Pl. 7.)

CONCLUSIONS

The varieties of iris considered in this circular, with the exception of *Iris tingitana* and the English group, are adapted to a wide variety of conditions. They are now successfully grown in all the Pacific Coast States and in the eastern United States as far south as the Carolinas, Tennessee, and Kentucky.

So far as present experience goes, California seems to be best adapted to the production of *Iris tingitana.* It is probable that with irrigation, situations in Arizona may prove suitable. The English group should not be attempted in a region having hot summers, although these varieties may be enjoyed as far south as Washington, D. C., at least for one or two years, and with special care even longer. Special care is necessary in their culture, however, to prevent bruising, molding, heating, desiccation, and accumulation of aphids and mites; and even more care is required with the English group than with the others, although it seems to be less subject to the attacks of insects.

Attention of iris breeders to these groups is necessary for the purpose of creating adaptable varieties and eliminating broken stocks.

The varieties of the English group are not at all hopeless, as has sometimes been thought. If properly grown and handled the bulbs can be transported without loss to any market in the country and can be held a month or more in reasonably good storage.

Since the accumulation of the newer, better Dutch varieties, it would seem that there may be a restricted use of the Spanish group.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

March 6, 1928

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